

A. Hanger rods shall be galvanized steel or cadmium plated, 6 mm minimum diameter.

1. Hardware rods shall be fastened to structural steel members with suitable beam clamps or to concrete inserts set flush to the surface.

## 2.7 **HARDWARE FINISH**

A. Hardware finish for concrete inserts, pipe straps, nuts, bolts, washers, screws, etc. shall be galvanized or cadmium plated.

## 2.8 **MISCELLANEOUS**

A. The Contractor shall furnish and install necessary locknuts, bushings, pipe clamps, ground clamps, supports, pull boxes, mounting bolts, inserts, lugs and such other materials, as may be necessary and proper in the execution of this work.

## **PART 3 EXECUTION**

### 3.1 **LABOR AND SUPERVISION**

A. Workmanship shall be in accordance with best practices of trade. Electrical work shall be installed under direct supervision of an electrical engineer.

### 3.2 **LAYOUT AND COORDINATION**

A. Contractor shall be responsible for laying out work on site in conformance with contract documents and shall be responsible for damage caused by reason of inaccuracy on his part. Contractor shall take field measurements necessary for his work and shall be responsible for their accuracy.

B. Contractor shall coordinate location of equipment, conduit, outlets, etc. in proper relationship to work specified elsewhere. When other work interferes with this locations, Contractor shall bring matter to attention of Owner's Representative whose decision will be final as to which shall take precedence. Where this is not done, Owner's Representative reserves right to make such changes in work as are necessary to avoid interference, and such changes shall not be considered as extra work.

C. Contractor shall carefully refer to room dimensions, door swings and locations of other equipment for location of outlets. In the event of discrepancy with electrical drawings, Owner requirement shall govern. Provide electrical service and connections to items so requiring in other divisions. Contractor shall check such drawings and specifications, other than electrical, to so determine.

D. Ceiling lighting fixture outlets shall be located for symmetrical installation of lighting fixtures between beams, walls, breaks in ceilings, etc. unless specifically shown or dimensioned on the drawings.

- E. Contractor shall keep himself fully informed of progress of general construction, and shall install his work that is concealed and built into building, in place, insufficient time to ensure proper location, without delays to work of other trades. Properly attend electrical work during progress of building-in to prevent misalignment of and damages to electrical work.

### **3.3 CUTTING AND PATCHING**

- A. Do cutting, fitting or patching of work that may be required to make its several parts come together properly, and fit it to receive, or be received by work of others, shown upon or reasonably implied by the drawings and specifications.
- B. Avoid cutting into work of others by using sleeves, inserts, chases, etc. The Contractor, in whose work it shall be necessary to use these methods, shall build same into his work, but this Contractor shall be responsible for the correct size and location of same, and shall furnish sleeves and inserts.
- C. If necessary to cut into the work of another Contractor it shall be done by that Contractor, at this Contractor's expense or by this Contractor with the consent of the other Contractor. Patching made necessary by such cutting shall be executed in the same manner.
- D. Cutting shall be done with such tools and methods as will prevent damage to surrounding building areas or equipment, and shall be performed in a neat and orderly manner.
- E. Building structural members shall not be drilled, punched, cut, burned, or welded without approval of Owner's Representative. This Contractor will be responsible for damage he inflicts on the building structure.

### **3.4 DAMAGE TO OTHER WORK**

- A. This Contractor shall be held responsible for damage to other work caused by this work, or through the neglect of this workmen. Patching and repairing of damaged work shall be done by workmen of the proper trade, but the cost of same shall be paid for this Contractor.

### **3.5 PAINTING**

- A. Patched wall surfaces, boxes, or other equipment installed will be finish painted under other sections of these specifications.
- B. Factory finished equipment shall be handled with care, to avoid marring the finish. Finishes damaged during installation shall be repaired to the satisfaction of the Architect/Engineer to Owner's Representative by this Contractor. Also, prime coats shall be made and kept intact by this Contractor.

- B. Operate each wall switch with circuit energized and verify proper operation.
- C. Verify that each receptacle device is energized.
- D. Test each receptacle device for proper polarity.
- E. Test each GFCI receptacle device for proper operation.

### 3.5 **ADJUSTMENT & CLEANING**

Clean installed work.

Clean exposed surfaces to remove splatters and restore finish.

Adjust devices and wall plates to be flush and level. Where outlet boxes are not within 4mm of the finish wall surface, install an extension ring or reinstall outlet box to bring it to within 4mm of the surface in order to provide secure support for the device.

Protect all devices and plates from paint and construction material. All devices and plates shall be clean, undamaged and unscratched.

## **LIGHTING FIXTURES**

### **PART 1 – GENERAL**

#### **DESCRIPTION**

The work required under this section consists of the supply, installation, testing and commissioning of the lighting fixtures and associated equipment and materials.

#### **QUALITY ASSURANCE**

- A. Industry Referenced Standards: The following specifications and standards are incorporated into and become part of this specification by reference. Except where a specific date is given, the issue in effect (including amendments, addenda, revisions, supplements and errata) on the date of invitation for bids, shall apply. In text, such specifications and standards are referenced to be basic designation only.

International Electrotechnical Commission (IEC)

The National Fire Protection Association:  
National Electrical Code  
Underwriter's Laboratories, Inc.

- A. Polyvinyl Chloride (PVC) Conduit shall be schedule 40 heavy wall rated for 90 C conductors and UL listed for aboveground and underground uses in accordance with PEC article 5.6.3. Conduit shall conform to NEMA TC-2 and UL -651 standards.
- B. Fittings such as couplings, elbows, offsets, conduit adapters, etc. shall be fabricated from same material as conduit.

### **PART 3 EXECUTION**

#### **3.1 APPLICATION**

- A. Unless otherwise indicated all types of conduit shall be Intermediate metal conduit to be installed for exposed interior wiring, in concrete slabs, in exterior walls, for exposed exterior wiring, and as shown on drawings except as may be specifically accepted elsewhere in the specifications.
- B. Rigid PVC conduit shall be used for underground work only as indicated in the drawings. The conduit shall be concrete encased under paved areas and other location as noted on the drawings. PVC conduit shall also be used in corrosive areas as defined on the drawings, and concealed in floors and walls whenever possible.
- C. All 20 mm and 25 mm diameter conduit sizes if embedded in concrete shall be Rigid PVC conduit and remaining type and sizes of conduit shall be rigid steel conduit or unless otherwise indicated in the drawing.
- D. Flexible liquidtight PVC jacketed steel conduit shall be used for connections to motors and equipment subject to vibration and in wet or damp locations.
- E. Pendant mounted lighting fixtures shall be supported using rigid steel conduit without exception.
- F. Minimum size conduit shall be 15 mm unless otherwise noted.

#### **3.2 INSTALLATION**

- A. Exposed conduit shall be run parallel or perpendicular to building walls and shall be kept as inconspicuous as possible.
- B. Conduits shall be concealed in walls and floors, wherever possible. In areas where there are dropped ceilings, conduits shall be installed above ceiling.
- C. Conduits and cable trays may be exposed in mechanical equipment rooms.
- D. Concealed conduit shall be run in straight lines with long sweep bends and offsets.
- E. Conduit entries through building walls below grade shall be made watertight by means of manufactured fittings. Fittings shall provide sleeve through wall having neoprene

ring gasket which can be compressed for positive seal between entering conduit and fitting body.

- F. Underground conduits entering areas below grade shall be arranged to drain water that may enter conduit system. Where possible conduits shall pitch away from building to exterior manholes. Junction boxes at conduit entries within building shall be provided with drain holes.
- G. Where conduits penetrate fire walls or partitions, pack openings with mineral fiber or approved insulation to maintain integrity of fire barriers.
- H. Conduit connections to pull boxes, safety switches, etc. shall be made by use of double steel locknuts. The conduit system, including pullboxes, shall form a continuously conductive grounding system.
- I. Conduits shall be protected immediately after installation by means of installing flat, noncorrosive, metallic discs and steel bushings at each end. Discs shall not be removed until necessary for pulling cable. Prior to pulling of cables, steel bushings and metallic discs shall be removed and phenolic insulating bushings shall be installed on end of each conduit of 25 mm size and over.
- J. No horizontal runs of conduits may be installed in masonry walls, except by specific permission of the Owner's representative.
- K. Conduit shall be substantially supported by pipe straps, or suitable clamps or hangers. Attached to structure of building to provide substantial and rigid installation. Joint use of hangers with heating and plumbing lines will not be permitted.
- L. Expansion joints shall be provided in conduit systems that cross building expansion joints or for raceways exceeding 30 meters. Bonding straps shall be used to provide continuous ground around expansion joint.
- M. For 20 mm and 25 mm diameter size Rigid PVC conduit embedded in concrete, provide special fitting such as adapter for joining or connecting between PVC and rigid steel conduit. Adapter fitting shall be embedded in concrete and there will be no exposed part of PVC conduit.

### 3.3 CONDUIT IN SLABS

- A. Conduits in structural slabs shall be placed between upper and lower layers of reinforcing steel and shall be spaced at least 200 mm apart. 20 mm conduits may be used in 110 mm and thicker slabs. 25 mm conduits may be used in 130 mm and thicker slabs. Maximum conduit size shall be 40 mm in structural concrete slabs. Conduits running parallel to slab supports such as columns, beams and walls shall not be installed less than 300 mm from such elements. Conduits shall have a minimum of 40 mm of concrete all around.

## **WIRES AND CABLES FOR 0-600 V CIRCUITS and POWER CABLES**

### **PART 1 - GENERAL**

#### **1.1 DESCRIPTION OF WORK**

- A. Provide building wires, power cables, control cables, flexible cords, splices, taps, and termination's as required for electrical work covered by the Contract Documents.

### **PART 2 PRODUCTS**

#### **2.1 BUILDING WIRES FOR 600 VOLTS AND LESS**

- A. General
  - 1. Conductors shall be new and shall show the name and trademark of the manufacturer and shall be tagged showing acceptance by Underwriter's Laboratories. Conductors shall be identified in accordance with Philippine Electrical Code color coding. Conductors shall be 600 volt insulated and shall be 3.5 mm<sup>2</sup> or larger unless otherwise noted. Sizes larger than 3.5 mm<sup>2</sup> are noted on the drawings.
  - 5. Conductors shall be stranded copper.
  - 6. Conductors used in fluorescent fixture channels shall be rated 90°C.
  - 7. Conductors for power circuits shall be type THHN/THWN.
  - 8. Equipment grounding conductors shall be green or have the ends taped with green tape and shall be type TW.
  - 6. Conductors for wiring in high ambient areas shall be stranded flexible tinned copper. Silicone rubber insulated with heat and moisture resistant glass braid jacket, rated 200°C intermittent operating temperature, 180°C continuous.
- B. Insulation Types shall be as follows:
  - 1. Type THHN conductor insulation shall be polyvinyl chloride plastic. Rating shall be 90°C in wet or dry locations.
- C. Approved Product Manufacturers or approved equal.
  - 1. Insulated copper, annealed conductors:

## 2.2 FLEXIBLE CORDS

- A. Flexible cords shall be furnished for pendent connections to lighting fixtures and connections to portable equipment.

## 2.3 CONTROL CABLE

- A. Multiple conductor control cables shall be rated 600 Volts, shall have outer jacket as specified, and be suitable for installation in open, air, ducts, conduit, or direct burial.
- B. Conductors: Stranded soft copper or number shown.
- C. Insulation: As specified below with stranded IPCEA Color Coding.

## 2.4 POWER CABLE

- A. Power cables shall be rated as specified, 133% shall have outer jacket as specified, and be suitable for installation in open or direct burial.
- B. Conductors: Copper
- C. Insulation: XLPE Insulation, Extruded Semi-Conductive Conductor
- D. Temperature: 90 degrees C up to 250 degrees C short circuit condition

# PART 3 EXECUTION

## 3.1 CONDUCTOR INSTALLATION

- A. Interiors of conduit shall be clean and dry before pulling wire. If dirt or moisture has entered conduits contractor shall swab them clean.
- B. Care shall be exercised while installing wire in conduits so as not to injure conductor insulation. Use only UL listed wire pulling lubricants for pulling-in conductors.
- C. Free ends and loops of wire at boxes and enclosures shall be pushed back in box and protected by blank covers or other means until the interior painting or decorating work is completed.

## 3.2 CONDUCTOR IDENTIFICATION

- A. The conductors of branch circuits for power and lighting shall be color coded for identification purposes in accordance with Article 5.3 of the Philippine Electrical Code. Refer to Section 16055 of these specifications.
- B. Power feeders for 600 volts and below shall be color coded by using permanent-colored, non - aging insulating tape.

- C. Branch circuits shall be connected as numbered on drawings. Test and permanently tag by circuit number each circuit wire, except neutrals, in panel gutter before connecting to panels, using numbered tapes.
- D. Terminal strips shall be lettered or numbered, and numbered or lettered tapes shall be attached to conductors connected through terminal strips.

### 3.3 SPLICES, TAPS AND TERMINATIONS

- A. Splices and taps of conductors 5.5 mm<sup>2</sup> and smaller shall be made using electrical spring connectors with vinyl insulating caps.
- B. Splices and taps of conductors larger than 5.5 mm<sup>2</sup> shall all be made by split-bolt type connectors. Finished splice or tap shall be insulated with one layer of vinyl backed mastic followed by two half-lapped layers of electrical tape or premolded caps or heat shrinkable tubing.
- C. Feeder conductors shall be terminated with pressure bolt type lugs.
- D. Conductors for other than feeders shall be terminated using pressure bolt type terminals. Where connections are to be made under screw heads only, install insulated crimp type spade lugs on stranded wire ends before connections are made.
- E. Connectors shall contain only one wire unless listed for multiple conductors.
- F. Feeder cables shall be continuous without splices.

### 3.4 TESTING

- A. Continuity shall be checked by means of a DC test device using a bell or buzzer. Circuit and phase identification tags shall comply with 3.2 above.
- B. Lighting circuit shall be identified and shall pass operational tests to see that the circuits perform functions for which they are designed.
- C. Cable connections must pass a visual inspection for workmanship and conformance with standard practice.
- D. Conductors and leads shall be tested for continuity. Feeder and branch circuits shall be given a megger test using 1000 volt motor driven megger.
  - 1. Megger tests shall be made between one conductor and ground with the other conductors grounded. Each conductor shall be tested in the same manner. Megger readings for cables connected at both ends shall be recorded.
  - 2. Each feeder conductor shall be meggered with the cable connected to the open breaker at the equipment. Connections at the other end of each of these cables shall be as follows:  
/



## WIRING DEVICES

### PART 1 – GENERAL

#### 1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Device plates and decorative box covers.
- D. Access floor box.

#### 1.2 RELATED SECTIONS

- A. Section 16130 - Boxes.

#### 1.3 REFERENCES

- A. Philippine Electrical Code
- B. NECA - Standard of Installation.
- C. NEMA WD 1 - General Requirements for Wiring Devices.
- D. NEMA WD 6 - Wiring Device -- Dimensional Requirements.
- E. NFPA 70 - National Electrical Code.
- F. PEC - Philippine Electrical Code

#### 1.4 SUBMITTALS

- A. Product Data: Submit three (3) manufacturer's sample or catalog information showing each dimensions, colors, configuration and etc. Final selection shall be made by the Architect.

#### 1.5 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

#### 1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 or PEC.
- B. Provide Products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

## **PART 2 PRODUCTS**

### **2.1 WALL SWITCHES**

- A. Description: NEMA WD 1, Heavy-Duty, AC only general-use snap switch.
- B. Body and Handle: Ivory plastic with toggle handle.
- C. Ratings:
  - 1. Voltage: 300 volts, AC.
  - 2. Current: 15 amperes.
- D. Ratings: Match branch circuit and load characteristics.

### **2.2 RECEPTACLES**

- A. Description: NEMA WD 1, Heavy-duty general use receptacle.
- B. Device Body: Ivory plastic.
- C. Configuration: NEMA WD 6, type as specified and indicated.
- D. Convenience Receptacle: Type as indicated.
- E. General purpose receptacle are 20 ampere 250 volt 3 pin grounding type.
- F. GFCI Receptacle: Convenience receptacle with integral ground fault circuit interrupter to meet regulatory requirements.

### **2.3 WALL PLATES**

- A. Decorative Cover Plate: Ivory, smooth plastic, modern plate.
- B. Jumbo Cover Plate: Ivory, smooth plastic, modern plate.
- C. Weatherproof Cover Plate: Gasketed cast metal with gasketed device cover. Weatherproof accessories are to be of non-corroding metal or polycarbonate enclosure with a IP56 rating.

## **DIGITAL KILOWATT-HOUR METER**

- A. Manufacturers or approved equal.

## **PART 3 EXECUTION**

### **3.1 EXAMINATION**

- A. Verify existing conditions prior to beginning work.
- B. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- C. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.

### **3.2 INSTALLATION**

Install in accordance with NECA "Standard of Installation."

- B. Install switches with OFF position down.
- C. Install receptacles with grounding pole .
- D. Install decorative plates on switch and receptacle in finished areas.
- E. Connect wiring devices by wrapping conductor around screw terminal.  
Use jumbo size plates for outlets installed in masonry walls.

Connect the grounding terminal of each device to the equipment grounding conductor of the circuit and connect to the metallic outlet box grounding lug with a pig-tail conductor. The connection shall be made with a conductor pig-tail such that removal of the device will not interrupt the ground continuity of the downstream devices.

### **3.3 INTERFACE WITH OTHER PRODUCTS**

- A. Install wall switch 1.2 m above finished floor.
- B. Install convenience receptacle 300 mm above finished floor.
- C. Install convenience receptacle 150 mm above counter or backsplash of counter.

### **3.4 FIELD QUALITY CONTROL**

- A. Inspect each wiring device for defects.

Replace all metal halide lamps which have a discernable color shift after 100 hours of operation.

## **EMERGENCY LIGHTING**

### **A. Mains Supply**

Before commissioning, ensure mains supply has been continuously connected for at least 24 hours.

### **B. Single-Point Systems**

Disconnect the mains supply to each general lighting final sub-circuit and verify the correct operation of luminaires and exit signs for a continuous period of 2 hours. Then restore normal supply and verify the operation of the indicator lights on each luminaires.

### **C. Record test results for all circuits and luminaires and provide format to record future maintenance testing.**

## **GROUNDING**

### **PART 1 GENERAL**

#### **1.1 DESCRIPTION OF WORK**

Grounding systems shall be installed in accordance with requirements of Philippine Electrical Code.

Switchgear, transformers, panelboards, system neutrals, conduit system, telecom, grounding bus and electrical equipment shall be grounded.

The building electrical system is 3 phase, 3 wire plus protective ground supplemented with an equipment grounding system. The equipment grounding system shall be established with equipment grounding conductors. The use of metallic raceways for equipment grounding is not acceptable.

Driven electrodes, earth pits, connection to building structured elements, copper, strapping etc. as appropriate to be included.

Building grounding shall be provided as shown.

### **PART 2 PRODUCTS**

#### **2.1 GROUND RODS ✓**

Copper clad steel, 20 mm X 3 M

**2.2 BARE COPPER WIRE**

Soft Drawn

**2.3 BRASS CONNECTORS**

Bolt type or exothermic weld.

**PART 3 EXECUTION**

- 3.1 Ground conductors for electrical equipment shall be sized in accordance with Meralco and Philippine Electrical Code Article 4.2 when not indicated on drawings. Double locknuts shall be used at box connections on feeder and motor circuits.
- 3.2 Grounding bus bars as shown in the plans shall be provided. These grounding bus shall have riser connected to the ground loop.
- 3.3 Connections, cable to cable, between cable and ground rods, or cable and steel shall be made by bolt type connectors or exothermic weld connection. Buried connections shall be covered with cold pitch and wrapped with tape.
- 3.4 Ground rods shall be installed at locations shown on drawings.
- 3.5 Bonding: Metallic conduits entering switchboards, MCC's substations, and other equipment fed from substations shall be bonded by means of bonding bushings with copper cable jumpers to ground bus.
- 3.6 Flexible connections to motors shall be jumpered with flexible copper equipment grounding conductor.
- 3.7 Receptacle Grounding: Green pigtail shall be installed from grounding screw of grounding outlets to outlet box in each instance where receptacle attachment bar is not approved as self grounding type.
- 3.8 Ground all non current carrying parts of the electrical system, i.e., wireways, equipment enclosures and frames, junction and outlet boxes, machine frames and other conductive items in close proximity with electrical circuits, to provide a low impedance path for potential grounded faults.
- 3.9 Lighting fixtures shall be grounded with a green insulated ground wire secured to the fixture with a bond lug, screw, or clip specifically made for such use.
- 3.10 Equipment bonding jumpers shall be installed inside raceways.

- 3.11 Grounding conductor for branch circuits are not shown on the drawings, however, grounding conductors shall be installed with all branch circuit raceways and cables. Grounding conductor shall be as noted otherwise on the plan.
- 3.12 Grounding conductors for feeders will be installed. Where the grounding conductor size is not indicated in the drawings, the conductor shall be sized in accordance with the equipment grounding conductor table of the Philippine Electrical Code.
- 3.13 A grounding conductor will be installed in all flexible conduit installations. For branch circuits the grounding conductor shall be sized to match branch circuit conductors.
- 3.14 The equipment grounding conductor shall be attached to equipment with a bolt or sheet metal screw used for no other purpose. Where the grounding conductor is stranded, attachment shall be made utilizing a lug attached to the grounding conductor with a crimping tool
- 3.14 Ground all motors by drilling and tapping the bottom of the motor junction box and attaching the equipment grounding conductor to the box with a round head bolt used for no other purpose. Conductor attachment shall be through the use of a lug attached to the conductor with crimping tool.
- 3.15 Equipment grounding conductors shall terminate on the panelboard or switchboard ground bus only. Do not terminate on the neutral bus. Provide a separate termination lug for each conductor. Conductors shall terminate in the same section as the phase conductors originate. Do not terminate neutral conductors on the ground bus.
- 3.16 Effectively earth all metal work in the vicinity of switchboards. Do not earth equipment via a neutral bus or the earth connection.
- 3.17 Ground Resistance: This Contractor shall furnish instruments for and measure ground resistance of entire main grounding system and each rod. Measured resistance of entire system for building and substations shall not exceed 5 Ohms.
- 3.18 Resistance test of each ground rod and of entire system, where specified, shall be determined by "fall-of-potential" method using either a ground Ohmer or megger ground tester. Owner's Representative shall be notified in writing 24 hours in advance of test and test shall be performed in the presence of the Owner's Representative. Where minimum resistance as specified cannot be obtained with number of ground rods shown on drawings, additional rods shall be driven until desired resistance is obtained. Additional rods shall be located at least 3 meters from other rods.
- 3.19 Inspect wiring system junction point locations for proper grounding. Verify connections of grounds either mechanical, hydraulic or exothermic. Verify proper connections to all components of the grounding system. Note all system components which are interconnected and the type of connection.

## ELECTRICAL IDENTIFICATION

### PART 1 - GENERAL

#### 1.1 DESCRIPTION OF WORK

- A. Provide nameplates on the following types of equipment:
  - 1. Panelboards
  - 2. Safety Switches or Circuit Breakers
  - 3. Control Panels
  - 4. Control Devices
  - 5. Cabinets and Pull Boxes
  - 6. Receptacles
  - 7. Automatic Transfer Switch
  - 8. Transformer and related Electrical Equipment
  - 9. Switchgear/ Switchboard, Panelboard and related equipment directories.
  
- B. Provide color coding of branch circuit and feeder conductors for phase and voltage identification.
  
- C. Provide wire markers for:
  - 1. Branch Circuit Identification
  - 2. Control Wire Identification

### PART 2 PRODUCTS

#### 2.1 NAMEPLATES

- A. Equipment nameplates shall be engraved laminated phenolic, with white surface and black core. Use 3 mm thick material for plates up to 50 x 100 mm. Larger size, use 4 mm thick material.
  
- B. Edges of nameplates shall be chamfered 1 mm x 45 approximately. Lettering shall be gothic or normal block style. Space between lines shall be equal to width of the letters. Use 6mm minimum height letters which occupy four per 25 mm. Increase size to 20mm on largest plates. Lettering shall include name of equipment specific unit number and references to 'on-off' or other instructions applicable lettering on receptacles shall indicate branch circuit number and panel identification.

**2.2 WIRE MARKERS**

Shall be oil-resistant, adhesive backed vinyl film with legends etched into surface.

**PART 3 EXECUTION**

**3.1 CONDUCTOR COLOR CODE**

- A. Branch circuit and feeder conductors shall be color coded by furnishing conductors with colored insulation or by wrapping insulation with colored tape where exposed in junction boxes, pull boxes and cabinets. Color coding shall be as follows:
- B. 400 Volts, 3 Phase, 3 Wire
  - 1. Phase Conductors - Red (A), Yellow (B), Blue (C)
  - 2. Neutral - White
  - 3. Grounding - Green
- C. 230 Volts, 1 Phase, 2 Wire
  - 1. Phase Conductors - Black, Red
  - 2. Grounding - Green
- D. Branch circuit wiring shall maintain same wire coloring throughout circuit.

**3.2 CONDUCTOR LABELING**

- A. Each branch circuit conductor shall be labeled with wire markers to identify circuit number.

**3.3 NAMEPLATE ATTACHMENT**

- A. Except where adhesive is specified, other nameplates shall be securely attached using corrosion resistant metal screws.

**3.4 WIRING COLOR CODING FOR AUXILLARY SYSTEMS**

Color coding or wire markers of control wiring for equipment furnished by Owner or other trades shall be the same as the equipment marking or color coding.

**2.1 AUTOMATIC SWITCH EQUIPMENT**

Switches shall be UL listed for use in emergency system describe in NFPA No. 70 and shall be manufactured and tested in compliance with applicable requirements of UL 1008, NEMA KS1 and 2 and IEEE No. 472 or approved equal.

Complete factory assembled transfer equipment with electronic control designed for surge voltage isolation, voltage sensors on all phases of both sources, linear operator, permanently attached manual handles, positive mechanical and electrical interlocking, and mechanically held contacts. Equipment rated 1000 amps and less shall include quick-make, quick-break contact mechanisms for manual transfer under load.

- A. Project Drawings:



Refer to the project drawings for specifications on the sizes and types of transfer switch equipment, withstand and closing ratings, number of poles, voltage and ampere ratings, enclosures, and accessories.

All transfer switches and accessories shall be UL listed and labeled, tested per UL Standard 1008, and CSA Approved.

B. Ratings:

Transfer switches shall be rated to carry 100 percent of rated current continuously in the enclosure. Circuit breaker type transfer switches do not meet this specification shall not be accepted.

Transfer switches shall be continuously rated in ambient temperatures of -40 to +50 degrees C, relative humidity up to 95% (non-condensing), altitudes up to 10,000 feet and seismic zone 4.

Transfer switch equipment shall have a withstand and closing rating (WCR) in RMS symmetrical amperes greater than the available fault currents of 200,000 amperes, RMS symmetrical, at a power factor between 0.0 and approximately 0.20 at a maximum voltage of 480 a.c.

C. Construction:

Transfer switches shall be double-throw, electrically and mechanically interlocked, and mechanically held in both positions. Transfer switches rated through 1000 amperes shall be equipped with permanently attached manual operating handles and quick-break, quick-make over-center contact mechanisms suitable for safe manual operation under load. Transfer switches over 1000 amperes shall be equipped with manual operators for service use only under de-energized conditions.

Main switch contacts shall be high-pressure silver alloy. Contact assemblies shall have arc chutes for positive arc extinguishment. Arc chutes shall have insulating covers to prevent interphase flashover.

Provide one set Form C auxiliary contacts on both sides, operated by transfer switch position, rated 10 amps 250 VAC.

Enclosures shall be UL listed. The enclosure shall provide NEC wire bend space. The cabinet door shall be key-locking. Controls on cabinet door shall be key-operated. Provide switch position indicator lamps and power available lamps for both sources (four total) on the outside cabinet door.

Transfer switches shall be mounted in enclosures as designated on the drawings. Separate enclosures shall be the NEMA type specified. The cabinet shall provide required wire bend space at point of entry as shown on the drawings. Manual operating handles and all control switches (other than key-operated switches) shall be accessible to authorized personnel only by opening the key-locking cabinet door.

Transfer switches with manual operating handles and/or non key-operated control switches located on outside of cabinet do not meet this specification and are not acceptable.

D. Automatic Controls:

Control shall be solid-state and designed for a high level of immunity to power line surges and transients, demonstrated by test to IEEE Standard 587-1980. The control shall have optically isolated logic inputs, high isolation transformers for AC inputs, and relays on all outputs.

Solid-state undervoltage sensors shall simultaneously monitor all phases of both sources. Pick-up and drop-out settings shall be adjustable. Voltage sensors shall allow for adjustment to sense partial loss of voltage on any phase. Voltage sensors shall have field calibration of actual supply voltage to nominal system voltage.

Controls shall be provided with solid-state overvoltage sensors, adjustable from 100-130% of nominal, to monitor all phases of the normal and emergency sources. Provide adjustable time delay of 0.5 to 2.2 sec.

Controls shall be provided with a solid-state over and under frequency sensor to monitor the normal and emergency sources. Pickup bandwidth shall be adjustable from a minimum of  $\pm 4\%$  to a maximum of  $\pm 20\%$  of nominal frequency. Dropout shall be  $\pm 5\%$  of nominal wider than pickup frequency bandwidth. Adjustable time delay shall be from 0.1 to 15 sec.

Automatic controls shall signal the engine-generator set to start upon signal from normal source sensors. Solid-state time delay start, adjustable from 0 to 5 seconds (factory set at 2 seconds) shall avoid nuisance start-ups. Battery voltage starting contacts shall be gold, dry type contacts factory wired to a field wiring terminal block.

The switch shall transfer when the emergency source reaches the set point voltage and frequency. Provide a solid-state time delay on transfer, adjustable from 0 to 120 seconds.

The switch shall retransfer the load to the normal source after a time delay retransfer, adjustable from 0 to 30 minutes. Retransfer time delay shall be immediately bypassed if the emergency power source fails.

Controls shall signal the engine-generator set to stop after a time delay, adjustable from 0 to 10 minutes, beginning on return to the normal source.

Power for transfer operation shall be from the source to which the load is being transferred.

The control shall include latching diagnostic indicators to pinpoint the last successful step in the sequence of control functions, and to indicate the present status of the control functions in real time, as follows:

Source 1 OK  
Start Gen Set  
Source 2 OK  
Transfer Timing  
Transfer Complete  
Retransfer Timing  
Retransfer Complete  
Timing for Stop

The control shall include provisions for remote transfer inhibit and area protection.

Transfer switches as designated on the drawings, shall be equipped with a field adjustable time delay during switching in both directions, during which time the load is isolated from both power sources, to allow load residual voltage to decay before closure to the opposite source. The delay feature shall have an adjustable range of 0 to 7.5 seconds. Phase angle monitor is not acceptable.

E. Front Panel Devices:

Provide devices mounted on cabinet front consisting of:

A key-operated selector switch to provide the following positions and functions:

Test - Simulates normal power loss to control for testing of generator set. Controls shall provide for a test with or without load transfer.

Normal - Normal operating position.

Retransfer - Momentary position to override retransfer time delay and cause immediate return to normal source, if available.

Non-automatic Controls transfer switches designated on the drawings, shall be provided with a non-automatic control. The control shall operate the transfer switch position either by a remote contact opening or closing, or by a front panel mounted selector switch. The selector switch shall be a three-position switch. In the center Auto position the transfer switch shall transfer and retransfer in response to input signals as shown. The key shall be removable with the selector switch in the Auto position only. Turning the selector switch to the Emergency position shall transfer load to an energized emergency power source. Turning the selector switch to the Normal position shall transfer load to an energized normal power source.

F. Accessory Items:

Transfer switches as shown on the drawings shall be equipped with accessories as follows:

1. Meters: Provide an AC Voltmeter, an Ammeter, and a Frequency meter; 2.5 inch, analog, 2% accuracy. Provide a phase selector switch to read L-L voltage and current of both power sources.

2. Exerciser Clock: Provide solid state exerciser clock to set the day, time, and duration of generator set exercise/test period. Provide a with/without load selector switch for the exercise period.
3. Battery Charger: Provide a float charge battery charger rated 10 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and fused DC output. Include fault indications and Form C contact for AC Fail, High Battery Voltage, and Low Battery Voltage.
4. Battery Charger: Provide a float charger battery charger rated 2 amps. DC output voltage shall be as required for the starting batteries. An ammeter shall display charging current. The battery charger shall have fused AC input and DC outputs.
5. Manual Selector Switch: Provide a manual/automatic retransfer selector switch to provide either automatic retransfer after the retransfer time delay, or a manual retransfer when selected by an operator.
6. Load Shed: Provide a load shed relay, to move the transfer switch from the emergency position to a neutral position, on receipt of a signal from a remote device.
7. Signal Module: Provide signal module, to delay the transfer and retransfer of the switch for up to 50 seconds to provide a pretransfer warning signal contact. Provide signals for the following conditions:
  - source 1 available
  - source 2 available
  - test/exercise
  - backup source availableContacts for these functions are to be form C type, rated for 120 VAC or 30 VDC at amps.
8. Phase Sequence Monitor/Balance Module: Provide Phase Sequence Monitor and Balance module to protect against inadvertent phase rotation hookup and monitor for voltage phase imbalance between phases.
9. Enclosure: The switch and accessories shall be in free-standing, floor-mounted and ventilated NEMA ICS 6 or equal, smooth sheet metal enclosure constructed in accordance with UL 1008 or equal. Gage of the metal shall be not less than 14. Doors shall have suitable hinges, locking handle latch, and gasketed jambs. The enclosure shall be equipped with one approved size and type of grounding lugs grounding the enclosure using 100 sq. mm copper conductors. The Contractor's field wiring terminating within the enclosure shall comply with NFPA No. 70 or Philippine Electrical Code equivalent. If wiring is not color coded, wires shall be permanently tagged near the terminal

at each end with the wire number shown on approved shop drawings. Terminal blocks shall conform to NEMA ICS 4 or equivalent. Terminal facilities shall be suitably arranged for entrance of external conductors from the top of the enclosure. Main switch terminals, shall be of the pressure type and suitable for the termination of copper conductors.

- a. Construction: The enclosure shall be constructed for convenient removal and replacement of contacts, coils, springs and control devices from the front without the removal of main power conductors or removal of major components.
- b. Cleaning and Painting: Ferrous surfaces shall be cleaned and painted. Surfaces to be painted shall be free of all oil, grease, welding slag and spatter, mill scale, deleterious corrosion, dirt and other foreign substances. Painting shall include at least one coat of rust-inhibiting primer and one coat of finish enamel. The rust-inhibiting primer shall be applied to a clean, dry surface as soon as practicable after cleaning. Painting shall be manufacturer's standard material and process except that the total dry film thickness shall not be less than 2.5 mils. Color of the finish coat may be the manufacturer's standard color. The finish shall be free from runs, sags, peeling or other defects.

### **PART 3 EXECUTION**

- 3.1 Contractor shall install and connect switchboard at the location as shown on the approved drawings. Provide necessary supports, framework, etc. as required for proper rigid installation.

## **PANELBOARDS**

### **PART 1 - GENERAL**

#### **1.1 SECTION INCLUDES**

- A. Distribution panelboards.
- B. Branch circuit panelboards.

#### **1.2 RELATED SECTIONS**

- A. Section 16170 - Grounding and Bonding.
- B. Section 16195 - Electrical Identification.

#### **1.3 REFERENCES**

- A. NECA Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA AB1 - Molded Case Circuit Breakers.

- C. NEMA ICS 2 - Industrial Control Devices, Controllers and Assemblies.
- D. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- E. NEMA PB 1 - Panelboards.
- F. NEMA PB 1.1 - Instructions for Safe Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment (published by the International Electrical Testing Association).
- H. NFPA 70 - National Electrical Code.

PEC - Philippine Electrical Code.

#### **1.4 SUBMITTALS FOR REVIEW**

- A. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, integrated short circuit ampere rating, circuit breaker and fusible switch arrangement and sizes.

#### **1.5 SUBMITTALS FOR INFORMATION**

- A. Submit manufacturer's installation instructions. Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, and installation of Product.

#### **1.6 SUBMITTALS FOR CLOSEOUT**

- A. Record actual locations of panelboards and record actual circuiting arrangements in project record documents.
- B. Maintenance Data: Include spare parts listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

#### **1.7 QUALIFICATIONS**

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience.

#### **1.8 REGULATORY REQUIREMENTS**

- A. Conform to requirements of NFPA 70 or PEC.

- B. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.9 MAINTENANCE MATERIALS

- A. Furnish two (2) of each panelboard key.

## PART 2 PRODUCTS

### 2.1 DISTRIBUTION PANELBOARDS

Description: NEMA PB 1, circuit breaker type.

- A. Service Conditions :
  - 1. Temperature :
  - 2. Altitude :

Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard.

Minimum integrated short circuit rating: As indicated.

Molded Case Circuit Breakers: NEMA AB 1, circuit breakers with integral thermal and instantaneous magnetic trip in each pole. Provide circuit breakers UL listed as Type HACR for air conditioning equipment branch circuits.

Controllers: NEMA ICS 2, AC general-purpose Class A magnetic controller for induction motors rated in horsepower, with bimetal overload relay. Coil operating voltage: 120 volts, 60 Hertz. Size as shown on Drawings. Provide unit mounted control power transformer and HAND-OFF-AUTO selector switch or STOP-START pushbutton station and RED, GREEN indicating light in front cover.

Circuit Breaker Accessories: Trip units and auxiliary switches as indicated.

Enclosure: As indicated, sizes as required.

Cabinet Front: Surface type, fastened with concealed trim clamps or screws, concealed hinged door with flush lock with key, metal directory frame, finished in manufacturer's standard gray powder coating enamel.

### 2.2 BRANCH CIRCUIT PANELBOARDS

- A. Description: NEMA PB1, circuit breaker type, lighting and appliance branch circuit panelboard.

- B. Panelboard Bus: Copper, ratings as indicated. Provide copper ground bus in each panelboard; provide insulated ground bus where scheduled.
- C. Minimum Integrated Short Circuit Rating: 10,000 amperes rms symmetrical for 240 volt panelboards or as indicated in the plans.
- D. Molded Case Circuit Breakers: NEMA AB 1, bolt-on type thermal magnetic trip circuit breakers, with common trip handle for all poles, listed as Type SWD for lighting circuits, Type HACR for air conditioning equipment circuits, Class A ground fault interrupter circuit breakers where scheduled. Do not use tandem circuit breakers.
- E. Enclosure: NEMA PB 1, Type 1/ Type 3R.
- F. Cabinet Box: As required.
- G. Cabinet Front: Flush / Surface cabinet front with concealed trim clamps, concealed hinge, metal directory frame, and flush lock all keyed alike. Finish in manufacturer's standard gray powder coating or enamel.

### **PART 3 EXECUTION**

#### **3.1 INSTALLATION**

- A. Install panelboards in accordance with NEMA PB 1.1 and the NECA "Standard of Installation."
- B. Install panelboards plumb. Install recessed panelboards flush with wall finishes.
- C. Height: 6 feet (1800 mm) to top of panelboard; install panelboards taller than 6 feet (1800 mm) with bottom no more than 4 inches (100 mm) above floor.
- D. Provide filler plates for unused spaces in panelboards.
- E. Provide typed or neatly handwritten circuit directory for each branch circuit panelboard. Revise directory to reflect circuiting changes required to balance phase loads.
- F. Provide engraved plastic nameplates under the provisions of Section 16195.
- G. Provide spare conduits out of each recessed panelboard to an accessible location above ceiling/ below floor. Minimum spare conduits: As indicated. Identify each as SPARE.
- H. Ground and bond panelboard enclosure according to Section 16170.

#### **3.2 FIELD QUALITY CONTROL**

- A. Field inspection, testing, and adjusting shall be performed.
- B. Inspect and test in accordance with NETA ATS, except Section 4.



- C. Perform inspections and tests listed in NETA ATS, Section 7.4 for switches, Section 7.5 for circuit breakers.

### 3.3 **ADJUSTING**

- A. Adjust installed work.

Measure steady state load currents at each panelboard feeder; rearrange circuits in the panelboard to balance the phase loads to within 20 percent of each other. Maintain proper phasing for multi-wire branch circuits.

## **ENCLOSED CIRCUIT BREAKERS**

### **PART 1 - GENERAL**

#### 1.1 **SECTION INCLUDES**

- A. Molded case enclosed circuit breakers.

#### 1.2 **RELATED SECTIONS**

- A. Section 16195 - Electrical Identification: Engraved nameplates.

#### 1.3 **REFERENCES**

NEMA AB 1 - Molded Case Circuit Breakers.

NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).

NFPA 70 - National Electrical Code.

PEC - Philippine Electrical Code.

#### 1.4 **SUBMITTALS FOR REVIEW**

- A. Product Data: Provide catalog sheets showing ratings, trip units, time current curves, dimensions, and enclosure details.

#### 1.5 **SUBMITTALS FOR INFORMATION**

Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include

instructions for storage, handling, protection, examination, preparation, and installation of Product.

## 1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing the Products specified in this section with minimum three (3) years documented experience, and with service facilities within 100 miles of Project.

## 1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70 or PEC.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

## 1.8 EXTRA PRODUCTS

- A. Furnish three (3) of each size and type of current limiter.

## PART 2 PRODUCTS

### 2.1 MOLDED CASE CIRCUIT BREAKER

- A. Circuit Breaker: NEMA AB 1.

### 2.2 PRODUCT OPTIONS AND FEATURES

- A. Accessories: As scheduled. Conform to NEMA AB 1.
- B. Shunt Trip Device: 120 volts, AC.
- C. Undervoltage Trip Device: 120 volts, AC.
- D. Auxiliary Switch: 120 volts, AC.
- E. Alarm Switch: 120 volts, AC.
- F. Electrical Operator: 120 volts, AC.
- G. Handle Lock: Provisions for sealing.
- H. Insulated Grounding Lug: In each enclosure.
- I. Products suitable for use as service entrance equipment where so applied.

### 2.3 ENCLOSURE

- A. Enclosure: NEMA AB 1, Type as required.
- B. Fabricate enclosure from steel.
- C. Finish using manufacturer's standard enamel finish gray color.

## PART 3 EXECUTION

### 3.1 INSTALLATION /

- A. Install in accordance with NECA "Standard of Installation."
- B. Install enclosed circuit breakers plumb. Provide supports in accordance with Section 16190.
- C. Height: 5 ft (1500 mm) to operating handle.
- D. Locate and install engraved plastic nameplates under the provisions of Section 16195.

### 3.2 **FIELD QUALITY CONTROL**

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1.

### 3.3 **ADJUSTING**

Adjust installed work.

Adjust trip settings so that circuit breakers coordinate with other overcurrent protective devices in circuit.

- C. Adjust trip settings to provide adequate protection from overcurrent and fault currents.

## **FIRE BARRIER**

### 1.0 **GENERAL**

- 1.1 The penetration seal (also referred to as "Fire Stop", Fire Barrier" or "Through Penetration Fire Stop") must provide the same fire resistance as the wall or floor in which the penetration opening is located.

The fire resistance of the penetration seal must be certified by either one of the following institutions:

- Fire Insurer's Research Corp. U.K. (FIRTO)
- Underwriters Laboratories U.S.A. (UL)
- Factory Mutual Eng. Corp. (FM)
- The German Institute for Construction Technology
- The institute TNO Netherlands (TNO)

The penetration seal must be rated for wall and floor penetration. A test report or approval listing for a wall penetration only is not acceptable for floor penetrations. On the other hand, test reports and approvals for floor penetrations are acceptable for both wall and floor installation.

The supplier must furnish proof that the tests are conducted with single cables, cables in multiple layers and cable bundles.

The manufacturer must furnish proof that the penetration seal was tested with at least 3 cable trays penetrating with trays being at least 40% by volume filled with cables.

Where aluminum cable trays are penetrating the opening, the penetration seal must have been tested with an aluminum tray.

## 2.0 REQUIREMENTS

The penetration seal must be unaffected by direct water exposure, moisture or prolonged exposure to humidity

Where a wet coating material, a putty or mastic are being used for the installation of the penetration seal, said materials must not contain components or substances which are hazardous to human health, i.e. toxic, carcinogenic or skin irritating.

The penetration seal must be unaffected and not lose its fire protective effectiveness by aging. The ease of retrofitting, such as the addition of cables or other utilities is a mandatory requirement. Wherever retrofitting is expected to be frequent, a "fire pillow" type is preferable.

Where a pillow type of fire seal is required or specified, the fire pillows must be meet the following requirements:

A fire pillow type seal must meet the same fire protection requirements as listed above under "Requirements for Penetration Seals" as per PEC, NEC, NFPA requirements.

A fire pillow type seal must have been tested in an opening no less than 800 x 800mm, unsupported by cable trays or other utilities, withstanding the horse stream test as per UL 1479 or ASTM E-814.

A single fire pillow, when held over an open flame (Bunsen burner) for 5 minutes with the tip of the flame impinging on the bottom of the pillow, must not allow the filling material to run out.

Since it is expected that fire pillows, over prolonged periods of time and possibly aided by vibration, will "settle", i.e. compact, whereby in wall penetrations openings on the top side could develop, the fire pillows should counteract this by expanding during heat exposure.

Where required, the pillow – type penetration seal should be protected against theft or damaged by a metal screen with a wire gauge of no less than 4mm.

## **PAD MOUNTED TRANSFORMER, COMPARTAMENTAL TYPE.**

### **1.0 General**

Description and ratings. The transformer(s) shall be compartmental type. Indoor installation, loop feed, dead front. Manufactured in accordance to ANSI, IEEE and NEMA standard.

Coolant and insulating fluid shall be Envirotemp FR3 transformer fluid.

### **2.0 Rating**

The transformers shall be 2x1500kVA and 1x1000kVA. Primary voltage 34.5kV delta. Secondary voltage 240V wye, 4 wire, 60 Hz with two 2 ½% full capacity below normal taps. Impedance shall be 5.75%

400V OLTS

### **3.0 Construction**

#### **3.1 General**

##### **3.1.1 Tank**

The transformers shall be sealed-tank construction of sufficient strength to withstand a pressure of 25% greater than maximum operating pressure. Carbon steel plate is reinforced with external side wall braces as required. Tank seams are continuously welded using an automatic seam welded.

Each cooler assembly is individual is individually welded and receives a pressurized check for leaks prior to assembly on the tank. After the coolers are attached to the tank, the completed tank assembly is leak tested before it is painted. After the

transformer has been assembled and tested, preparations are made to weld the cover to the top tank flange.

### 3.1.2 Coils

Coils shall be wound with copper conductors.

### 3.1.3 Core

Cores shall be fabricated of high grade, grain oriented silicon steel laminations, carefully annealed after fabrication to restore high magnetic permeability. Magnetic flux is to be kept well below the saturation point.

## 3.2 Finish

Tank, radiators and terminal chambers, if provided, shall be treated to remove oil and scale by either shotblast or phosphatizing treatment to ensure proper paint adhesion. All exterior surfaces shall be primed, using a high quality catalyzed epoxy enamel. Minimum dry film thickness shall be 2mils. A modified alkyd top coat with a minimum dry film thickness of 1mil shall be applied to all primed surfaces. The color of the finish coat shall be coordinated with the switchgear manufacturer in order to match the color of the switchgear.

## 4.0 Standard Feature

- 2.1 The weather cover over the cabinet is provided with additional hold down hardware to secure it more firmly to the cabinet
- 2.2 Four lifting hooks
- 2.3 Bolted on terminal compartment with removable front sill
- 2.4 Hinged, lift-off cabinet doors.
- 2.5 Interlocked penta-head bolt/padlock handle operates a cam assembly which is part of the 3-point door latching mechanism.
- 2.6 For live front construction, externally clamped high voltage porcelain bushings with a single eyebolt for 4/0 cable.
- 2.7 For dead front construction, externally clamped high voltage bushing wells for loadbreak or non-loadbreak inserts.
- 2.8 Lightning arrester mounting pads (live front only).
- 2.9 Tank ground pads (1 in HV, 1 in LV)
- 2.10 Steel high/low voltage compartment barrier.
- 2.11 Two ½ "penta-head bolts must be removed from the flange formed on the steel high/low barrier before the H.V. door can be opened (1/2" hex-head bolts available as an option).
- 2.12 Externally clamped low voltage bushings with threaded copper stud for full load current below 2100 amps. Externally clamped integral low voltage bushings for current above 2100 amps. NEMA spades provided per ANSI hole requirements.
- 2.13 Nameplate.
- 2.14 Fill plug and self-actuating pressure relief device.
- 2.15 Drain valve with sampler.
- 2.16 Removable neutral ground strap.
  1. Five-legged core/coil assembly (inside tank)
  2. Handhole cover bolted onto tank top (protected by weathercover)

3. Panel-type coolers
- 4.17 Tap changer designed for de energized operation only.
- 4.18 Primary Termination
  - Externally-clamped bushing wells with loadbreak or non-Loadbreak inserts.
  4. Integral loadbreak bushings.
- 4.19 Secondary Termination
  5. Externally-clamped bushings with threaded copper studs to meet REA specification.
- 4.20 Primary Switching
  6. LBOR oil switch, loop or radical feed
  7. Externally operated series-multiple (dual voltage) switch.
  8. EFD air switch, radial feed, with current limiting fuse
- 4.21 Overcurrent Protection
  9. Internal primary protective links
  10. Bayonet-type fuses
  11. Drawout, loadbreak current limiting fuses, with or without interlocking transformer switch
  12. Secondary oil circuit breaker
  13. Internal, partial-range current limiting fuse.
- 4.22 Overvoltage Protection
  14. Distribution class, metal oxide arresters, 3 thru 36 kV ratings available.
  15. Under oil arresters.
- 4.23 Construction
  16. 24" and 30" deep terminal cabinet.
  17. Low profile design with hinged weather cover over the cabinet that can be raised for removal of Bayonet-type fuses.
  18. Drain valve and sampling device
  19. Mounting plate for CT's or PT's.
  20. Interphase barriers
  21. Molded case external secondary breakers.
  22. Accessories – Oil gauge, thermometer, drain valve and sampler, pressure-vacuum gauge provision.

## 5.0 Standard test

Ratio  
 Polarity  
 Phase Rotation  
 No-Load Loss  
 Excitation Current  
 Impedance Voltage  
 Load Loss  
 Applied Potential  
 Induced Potential

# MECHANICAL SPECIFICATIONS

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## 1.00 : SPECIFIC PROVISIONS

### 1.01 Scope of the Contractor

The work covered by this part of the specifications consist in performing all operations in connection with the supply and installation of the air conditions and ventilating system complete in strict accordance with this part of the specifications and applicable drawings and subject to terms and conditions of the contract.

### 1.02 General Condition

The contract drawings indicate the extent and general arrangement of the air conditioning and ventilating systems. If departures from the drawings are deemed necessary by the contractor, details of such departures and the reasons therefore shall be submitted to the Architect for approval. No such departure shall be made without the prior written of approval of the Architect or his authorized representative.

#### 102.1 Applicable Drawings:

All materials, machineries, and equipment to be furnished shall be of the required quality used in good commercial and trade practice and shall be essentially the standard products of reputable manufacturers. The acceptability of these items including their workmanship and method of installation shall be established by the following:

- a. The Philippine Mechanical Engineering Code
- b. The Philippine Electrical Code
- c. American Society of Heating, Refrigeration, and Air Conditioning Engineers (ASHRAE)
- d. Fire Code of the Philippines
- e. American Society of Mechanical Engineers (ASME)
- f. National Fire Protection Associations (NFPA)
- g. American Society of Testing Materials (ASTM)
- h. Air Moving and Conditioning Associations (AMCA)
- i. American National Standard Institute (ANSI)
- j. National Electrical Manufacturing Association (NEMA)
- k. Underwriter's Laboratory (UL)
- l. Safe Organization of the Phils., Inc.

#### 102.3 Equipment Schedule:

As soon as practicable, after date of the award of the contract, a complete schedule of equipment proposed for installation shall be submitted for the approval of the Architect/Engineer showing dimensions and



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arrangement of the equipment and necessary clearances. The schedule shall include catalogs, brochures diagrams, and drawings. In the event any items or equipment contained in the schedule fails to comply with the specifications, such item may be rejected.

**102.4 Shop Drawings:**

As soon as practicable, after award of the contract and prior to installation, complete shop drawings, showing the sizes and the type of equipment, together with complete piping layout and electrical connections, shall be submitted to the Architect/Engineer for approval. This holds true also for the air distribution ductwork and actual diffuser locations.

**102.5 As-Built Plans:**

Within a reasonable period but not ninety (90) days from date of completion and acceptance of the installation "As-Built" drawings shall be furnished the building Owner thru the Architect. The As-Built plans shall include all contract drawings with the necessary revisions and modifications resulting in change from the original drawings, supplemented by such schematic, isometric, or other types of drawings as may be necessary to provide a clear understanding of installed systems As-Built.

**102.6 Government Permits and Certificate of Inspection:**

Prior to start of installation, the contractor shall secure a permit to install from the authorized agency having jurisdiction over the place of installation and before final acceptance by the Owner a final certificate of inspection and a permit to operate the system shall be secured from the same government agency. Fees and other expenses due on these permits shall be borne by the contractors.

**102.7 Local Laws and Ordinances:**

Aside from herein specified the equipment and materials to be furnished and the installation of the system shall conform to local laws, codes and other ordinances that are in force.

102.8 If there are discrepancies between these specifications and the drawings the Architect/Engineer should be consulted.

**1.03 Coordination of Works done by others**

103.1 It shall be the responsibility of the contractor to closely coordinate his work with the works of the Building contractor, Electrical Contractor, Sanitary Contractor, and other to avoid conflicts and to insure the smooth and proper installation of the project.

103.2 This contractor shall carefully check space requirements to make sure that his equipment, air ducts, piping, dampers, motor controllers, etc. can be installed in the space allotted for the same.